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Progress Report of South Dakota Fertilizer Experiments 1953

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PROGRESS REPORT OF SOUTH DAKOTA FERTILIZER EXPERIMENTS 1953

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Progress Report of South Dakota Fertilizer Experiments in 1953

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The fertilizer experiments summarized in this progress report were conducted on private farms located in 24 counties. The trials were so distributed that the locations would be representative of the major crop and soil areas of the state.

The experiments were performed in order to determine the effect of the application of plant food in the form of commercial fertilizer on the yield of crops.

Climatic conditions in 1953 were, in general, favorable for the small grain and corn crop. In some areas, however, the seeding of the small grain was delayed by the cool, wet weather. Plant diseases reduced the yields of small grains, especially some spring wheat varieties.

The data from these field experiments serve as a guide for the determination of the kind and quantity of fertilizer to use and as a basis for estimating the effect of fertilizer use on crop yields. The crop response, resulting from fertilizer use, varies from year to year depending upon climatic conditions. The type of soil and the previous soil management practices may also have a considerable effect on crop response. This report gives the results of the fertilizer trials for 1953 only.

The individual farmer may use the results of these experiments as a basis for the determination of the kinds of fertilizer and rates of application which are most beneficial for his particular soil and soil management system.

In the following tables, the results of fertilizer treatments on the various crops are presented:

EFFECT OF FERTILIZER ON THE YIELD OF CORN
YIELD IN BU/ACRE

Treatment Lbs. per acre	Clay County Bu/Acre	Lincoln County Bu/Acre	Minnehaha County Bu/Acre	Roberts County Bu/Acre	Turner County Bu/Acre
0-0-0	68.8	60.1	59.1	55.0	70.8
0-40-0	68.2	64.0	63.5	54.3	78.1
40-0-0	72.2	76.9	72.8	60.8	69.8
20-40-0	68.6	82.8	64.8	57.2	70.9
40-40-0	62.4	81.2	79.0	60.8	68.1
60-40-0	62.7	81.9	82.8	58.1	75.6
*20-40-0	60.7	78.8	72.4	54.6	82.8
**40-40-0	69.4	88.8	78.2	62.1	80.1
***60-40-0	69.9	89.1	85.8	60.6	71.2
+80-40-0	68.9	90.6	87.8	58.8	73.3

* Side dressed with 20 lbs. nitrogen per acre at time of second cultivation.
** Side dressed with 40 lbs. nitrogen per acre at time of second cultivation.
*** Side dressed with 60 lbs. nitrogen per acre at time of second cultivation.
\+ 40-40-0 plowed down before planting and 40 lbs. nitrogen applied as a side dressing at time of second cultivation.
All other fertilizer was plowed down before planting.

Explanation of Fertilizer Treatments:

In the sequence of numbers listed under fertilizer treatments, the first number refers to the lbs. of N_2, the second number to the lbs. of P_2O_5 and the third to lbs. of K_2O applied per acre. Nitrogen was applied in the form of ammonium nitrate and phosphorus as treble super phosphate.

EFFECT OF FERTILIZER ON THE YIELD OF CORN
YIELD IN BU/ACRE

Treatment	Brookings County	Brown County	Grant County	Jerauld County	Hutchinson County
Lbs. per acre	Bu/Acre	Bu/Acre	Bu/Acre	Bu/Acre	Bu/Acre
0-0-0	41.0	59.8	58.1	51.3	52.0
0-40-0	46.9	55.8	50.5	50.0	49.9
40-0-0	57.0	62.3	67.6	60.4	53.8
20-40-0	52.3	62.1	54.7	57.3	51.7
40-40-0	55.8	58.7	57.1	62.9	55.0
60-40-0	62.6	64.4	63.9	54.8	52.4
*20-40-0	54.5	60.4	65.4	55.1	52.8
**40-40-0	56.6	58.0	64.7	58.8	56.8
***60-40-0	61.8	60.0	77.2	61.5	56.3
+80-40-0	62.9	66.0	76.8	64.0	54.0

* Side dressed with 20 lbs. Nitrogen per acre at time of second cultivation.
** Side dressed with 40 lbs. Nitrogen per acre at time of second cultivation.
*** Side dressed with 60 lbs. Nitrogen per acre at time of second cultivation.
\+ 40-40-0 plowed down before planting and 40 lbs. nitrogen applied as a side dressing at time of second cultivation.
All other fertilizer was plowed down before planting.

Cropping history and previous management.

The Turner, Clay and Hutchinson County locations had above average management. These management practices include use of legumes and the application of manure. The cropping system on the other locations was largely corn and small grains with limited use of legumes and manure.

Description of Soils.

Clay, Lincoln and Brown County locations were on moderately well drained soils. The other locations were on well drained upland soils. The following plot sites were on soils developed from a loess parent material: Clay, Lincoln, Minnehaha, and Brookings. The Brown County plot was on lake bed sediments. The others were on soils developed from glacial till.

Interpretation of results.

Past management practices have a strong influence on the yields of corn and the responses to fertilizer. The greatest response to fertilizer, especially nitrogen, will be obtained on those soils which have been under continuous cropping.

On those soils where the nitrogen requirements of the corn crop have been supplied by a good rotation (including a legume) or applications of manure, the response to commercial nitrogen fertilizer will probably be small.

Effect of Nitrogen and Phosphorus Fertilizers on Yield of Corn in Spink County - 1953

Treatments Lbs./Acre	Spink Co. Bu./Acre	Increase over check Bu./Acre
0-0-0	70.7	0.0
0-40-0	70.9	0.2
40-40-0	81.4	10.7
20-40-0	81.6	10.9
40-60-0	81.9	11.2
60-60-0	82.3	11.6
40-20-0	82.9	12.2
40-0-0	83.9	13.2
60-40-0	85.1	14.4
60-60-60-	89.5	18.8

Least Significant Difference at the 5% confidence level = 7.08 bu./acre

Seedbed Preparation and Time of Application

Fertilizer was broadcast on stubble in the spring and then plowed under.

Cropping History

A corn and small grain rotation was followed. Sweet clover was sometimes planted with the small grain and plowed under as a green manure. No green manure was plowed under immediately preceeding this experiment. No commercial fertilizer or manure has been applied within the last eight years.

Description of Soil

The plot site was located on a Maddock loamy sand. This soil was developed from a shallow mantle of wind deposited sands (2 to 3 ft. thick) over glacial till on gently undulating upland topography.

Interpretation of results

Differences less than the L.S.D. of 7.08 bushels must be attributed to chance or to unknown reasons and not to the effect of fertilizer treatment.

Phosphorus alone gave no response in yield in this field in 1953.

Nitrogen alone gave a highly significant yield response.

There were only minor and insignificant differences between the several combinations of nitrogen and phosphate used in this experiment.

The Effect of Broadcasting Nitrogen Fertilizer
on Corn at Time of Second Cultivation - 1953
Yield in Bu/Acre

Treatments Lbs./Acre	Brown County Bu./Acre	Lincoln County Bu./Acre
0-0-0	56.5	59.3
20-0-0	56.3	67.2
40-0-0	54.0	76.5
60-0-0	60.4	79.9
80-0-0	56.4	80.3

The broadcasting of Nitrogen fertilizer on corn is a recent practice. The results of this year and the results obtained in 1952 show that this method compares favorably with side dressing or plowing down of nitrogen fertilizer.

The Effect of Nitrogen and Phosphorus Fertilizer
on the Yield of Oats in Eastern South Dakota-1953,
Fertilizer Applied by Broadcasting in the Spring.

Treatment Lbs/acre	Lincoln County Bu/A	Clay County Bu/A	Minnehaha County* Bu/A	Lake County Bu/A	Grant County* Bu/A	Brookings County Bu/A
0-0-0	20.1	19.4	61.1	22.0	35.7	31.2
0-40-0	22.4	18.8	52.0	33.6	29.0	27.7
20-40-0	37.4	27.8	58.5	38.3	31.5	45.5
40-40-0	51.1	53.8	56.4	35.7	35.0	56.6
60-40-0	48.9	49.8	48.1	62.0	46.9	64.0
40-20-0	49.0	49.9	57.3	53.2	31.5	57.6
40-60-0	49.7	46.5	52.9	56.4	37.7	55.1
40-0-0	37.1	53.3	52.4	57.6	29.7	49.3

*Hail damage

Cropping History

The oats fertility plots were located on soils which had been largely under continuous cropping to corn and small grains. Little or no fertility had been restored to the soil through use of legumes, manure, and commercial fertilizer.

Description of soils

The locations in Grant and Minnehaha Counties were on well drained upland soils and the other locations were on moderately well drained soils. The plot in Grant county was on Barnes loam and the other locations were on loess soils.

Interpretation of Results

Oats responded well to nitrogen fertilizer in South Dakota in 1953.

In the two locations where hail damaged the grain, no response to nitrogen was evident.

The response to phosphorus when applied alone was small or none. There was more response to phosphorus when applied with nitrogen. Previous work has shown that the highest yields of oats will generally be obtained from fertilizer treatments containing both nitrogen and phosphorus.

Effect of Nitrogen and Phosphate Fertilizer on the Yield of Oats in Central South Dakota, 1953. Fertilizer applied by Broadcasting in the Spring.

Treatment Lbs./acre	Davidson County Bu./Acre	Charles Mix County Bu./Acre	Spink County Bu./Acre	Jerauld County(1) Bu./Acre
0-0-0	36.2	30.5	34.0	29.4
0-40-0	33.5	26.1	40.1	34.1
20-40-0	43.6	45.1	46.8	55.4
40-40-0	51.2	53.8	55.7	78.3
60-40-0	64.3	51.5	62.3	65.6
40-20-0	59.2	51.4	60.0	69.0
40-60-0	63.0	43.2	49.9	72.2
40-0-0	53.0	41.1	51.1	57.0
L. S.D. at 5% level			10.4 bu.	

(1) Fertilizer applied with seed by drill attachment.

Cropping History

A rotation of corn and small grain was followed, with no legumes or commercial fertilizer. Corn preceded oats in all four locations.

Description of Soils

The plots in Davidson and Charles Mix Counties were located on well drained upland soils. In Spink County the plot site was on an imperfectly drained lacustrine silt loam that had a moderately compact claypan horizon 1½ feet below the surface. The Jerauld County site was also on well drained upland.

Interpretation of Results

Nitrogen gave an increase in yield on all four locations.

Phosphate responses were limited and variable.

Effect of Fertilizer on Yield of Oats in Central and Western South Dakota - 1953

Treatment	Lyman County		Perkins County
	Location 1 Bu/A	Location 2 Bu/A	Bu/A
0-0-0	43.9	41.2	49.8
0-40-0	45.6	41.0	49.9
20-40-0	53.0	53.3	59.5
40-40-0	61.6	53.0	59.8
60-40-0	52.6	49.4	59.2
40-0-0	59.5	50.7	58.4
40-20-0	64.0	48.1	61.0
40-60-0	58.9	49.7	61.7
*40-0-0	56.4	51.4	55.5
*40-40-0	54.1	46.2	59.8

* The two treatments preceded by an asterisk were applied in the fall; the other eight treatments were applied in the spring.

In 1952 the crops grown in the three locations were intertilled row crops. Nitrogen produced an increase in yield while phosphorus gave small or no increases in yield for the three locations.

A Comparison of Fertilizer Applied by Broadcasting Before Planting, With Fertilizer Applied by a Drill Attachment, On the Yield of Barley-1953

Treatments Lbs./Acre	Brookings County	
	Fertilizer broadcast Bu/Acre	Drill Attachment Bu/Acre
0-0-0	18.4	18.4
0-40-0	18.2	25.2
40-0-0	28.6	26.6
20-40-0	32.6	30.6
40-20-0	37.9	44.6
40-40-0	39.9	53.8
40-60-0	46.1	39.4
60-40-0	38.6	46.2

Cropping history and soil

In 1951 - flax was planted with sweet clover. In 1952 - sweet clover was

plowed under in spring for corn, and 60 pounds of P_2O_5 was applied.

The soil was Kranzburg silt loam. This is a well drained upland soil consisting of a layer of wind blown silts over till.

Interpretation of results

The barley responded to both nitrogen and phosphorous fertilizer in the above experiment. Barley is one of the most responsive crops to phosphorous.

Phosphorous alone gave a greater increase in yield when applied with the drill attachment.

The method of application did not greatly influence the response of nitrogen applied alone.

Effect of Fertilizer on Yield of Barley - 1953

Treatment	Lyman County Bu/A	Perkins County Bu/A
0-0-0	49.1	29.5
0-40-0	50.7	27.8
40-40-0	56.7	43.5
40-0-0	54.7	43.1
40-20-0	52.9	42.8
40-60-0	50.2	42.4
*40-0-0	55.5	46.0
*40-40-0	51.0	40.5

* The two treatments preceded by an asterisk were applied in the fall; the other six treatments were applied in the spring.

Uniformly high yields of barley were obtained in Lyman County for all treatments. The preceding crop was corn. The corn crop was planted in such a way that there were two rows of corn alternated by the equivalent of 2 rows fallow.

The barley in Perkins County was grown on sloping land where the previous crop was oats.

Effect of Nitrogen and Phosphorus Fertilizer on the Yield of Spring Wheat-1953. Fertilizer Applied by Broadcasting in the Spring

Treatment Lbs./Acre	Brown County Bu/A	Edmunds County Bu/A	Faulk County Bu/A	Potter County Bu/A	Hand County Bu/A	Campbell County Bu/A
0-0-0	13.6	19.5	18.5	10.6	28.5	6.6
0-40-0	13.4	22.9	14.8	12.1	31.0	8.1
20-40-0	20.2	27.0	20.7	14.4	27.4	14.0
40-40-0	23.8	24.7	18.5	13.4	28.5	19.8
60-40-0	26.3	26.1	15.2	16.6	32.0	22.4
40-20-0	21.4	18.4	22.7	14.2	29.8	18.2
40-60-0	22.1	25.9	22.1	16.6	29.8	20.7
40-0-0	19.5	23.3	19.2	13.3	30.2	20.1

Cropping history and previous management

Mostly continuous cropping to corn and small grain was followed with limited use of manure and legumes. The location in Hand County had been fallowed in 50 and 51, wheat was planted in 52 and the stubble was disked and harrowed soon after harvest.

Description of soils

All plot sites were on well drained upland soils.

The location in Brown County was on lacustrine silts, and the Potter County site was on loess. Other sites were on soils developed from glacial till.

Interpretation of results

Nitrogen deficiencies are more general and pronounced in the spring wheat area than phosphate deficiencies.

For this reason, larger and more consistent responses are obtained from the application of nitrogen than from phosphate fertilizer.

The Hand County site gave a limited response to nitrogen due to previous treatment (fallow).

The response of spring wheat to fertilizer treatment was not as large nor as consistent as in previous years because of diseases and climatic factors.

The Effect of Nitrogen and Phosphorus Fertilizers on the Yield of Spring Wheat in Spink County, 1953 Fertilizer applied by Broadcasting in the Spring.

Treatment Lbs./Acre	Till derived soil Bu/Acre	Harmony soil Bu/Acre	Aberdeen soil Bu/Acre
0-0-0	3.3	14.5	2.2
0-40-0	3.7	18.1	2.2
20-40-0	7.5	19.7	3.3
40-40-0	9.2	22.4	2.8
60-40-0	11.2	20.5	4.0
40-0-0	9.9	17.7	2.9
40-20-0	10.1	19.6	3.0
40-60-0	10.5	19.8	3.7
L.S.D. at 5%	3.0	4.5	1.3

Cropping history

A system of continuous cropping to corn and small grain was followed on all three locations. No legumes, manure or commercial fertilizer had been used.

Description of soils

Till derived soils - Well drained upland soil developed on friable glacial till.

Harmony - Moderately well drained soil developed in lacustrine silts and clays. A slightly compact claypan has developed.

Aberdeen - An imperfectly drained soil developed in lacustrine silts and clays with an extremely compact claypan approximately 12 inches from the surface.

Interpretation of results

Till derived soil - Phosphorous alone or in combination with nitrogen gave little increase in yields. The application of 40 pounds of nitrogen more than doubled the yield.

Harmony - The yields, in general, were higher than the other plots due in part to the rust resistant variety which was grown. The response to nitrogen was not as great as expected. This was probably due to the fact that the stubble was plowed immediately after combining and just after a good rain in 1952. This semi-summer fallow must have stimulated organic matter decay, and the production of available nitrogen in the soil.

Aberdeen - Yields were very low and any possible response to fertilizer was masked by the dominating effect of rust damage. The time of seeding was delayed because of the imperfect drainage of this soil. The late grain was damaged more severely by the rust.

A Comparison of Two Methods of Fertilizer Application
on Spring Wheat in Spink County - 1953

Fertilizer Treatment Lbs/Acre	Beotia Soil		Beadle Soil	
	Fertilizer Broadcast Bu/Acre	Fertilizer Drilled Bu/Acre	Fertilizer Broadcast Bu/Acre	Fertilizer Drilled Bu/Acre
0-0-0	4.1	5.6	2.0	2.9
0-40-0	6.2	5.2	2.3	2.3
20-40-0	9.3	10.5	7.4	9.1
40-40-0	10.2	14.0	7.1	13.6
60-40-0	13.0	14.4	12.8	13.8
40-0-0	11.7	12.3	7.4	13.4
40-20-0	11.8	12.2	9.2	13.5
40-60-0	11.3	13.0	9.7	14.0

L.S.D. to compare yield differences due to amounts of fertilizer applied on the Beotia soil = 2.1 bu/acre.
L.S.D. to compare differences due to amounts of fertilizer applied on the Beadle soil = 2.5

Cropping history and previous management

Corn and small grain crops were alternated and no legume, manure, or commercial fertilizer used.

Description of soils

Beotia - Well drained friable soil developed in stone free lacustrine silts and clays. No claypan is present.

Beadle - Well drained soil developed from moderately friable clay loam glacial till. There is evidence of some accumulation of clay in the B_2 horizon, indicating the development of a mild claypan.

Interpretation of results

On these sites, phosphorous, either alone or in combination with nitrogen, gave no increases in yield in 1953.

Nitrogen gave substantial increases in yields on both soils, regardless of method of application. The highest rates of nitrogen did not materially increase the yields over the medium rate of application.

Fertilizer drilled with the wheat gave small but significant increases in yield over the fertilizer broadcast treatment.

Effect of Fertilizer on Yield of Spring Wheat in Perkins County - 1953

Treatment	Bu/Acre
0-0-0	6.2
0-40-0	6.7
20-40-0	8.4
40-40-0	12.0
60-40-0	12.8
40-0-0	12.6
40-20-0	11.2
40-60-0	10.6
*40-0-0	9.4
*40-40-0	10.0

L.S.D. at 5% confidence level = 2.6 bu/acre

* The two treatments preceded by an asterisk were applied in the fall; the other eight treatments were applied in the spring.

The crop grown in 1952 was corn. Due to an extremely wet spring, the wheat crop in this experiment got a poor start.

Effect of Fertilizer on the Yield of Winter Wheat - 1953

Treatment	Bennet County		Lyman County
	Location 1	Location 2	
	Bu/A	Bu/A	Bu/A
0-0-0	32.6	7.4	6.7
20-0-0	29.1	9.9	7.6
40-0-0	28.0	11.6	6.0
60-0-0	31.8	12.1	5.4
40-20-0	30.5	10.7	6.3
40-40-0	30.2	9.1	6.2
0-40-0	30.8	9.0	7.1
* 20-0-0	29.0	13.8	7.4
* 40-0-0	26.7	10.8	5.3
** 40-0-0	33.4	10.1	6.9

* The two treatments preceded by one asterisk were applied in the fall.

** The treatment preceded by two asterisks was applied June 15. The other seven treatments were applied in the fall.

Fertilizer did not prove worthwhile in any of the three experiments in 1953. Location 1, Bennet Co., wheat followed fallow. In location 2, the stand was so poor that the fertilizer did not get a fair chance even though wheat followed wheat. The wheat in Lyman Co. did not come up until spring. By harvest time the wheat was hit hard by stem rust.

Effect of Fertilizer Applied in the Spring Before Planting Time and Nitrogen Side Dressed at Time of Second Cultivation on the Yield of Potatoes-1953
Yield in Bu/Acre

Treatment Lbs/Acre	Clark County Bu/A
0-0-0	268.0
*40-0-0	273.0
60-0-0	289.9
*100-0-0	268.3
0-50-0	296.4
*40-50-0	291.5
60-50-0	307.8
*100-50-0	296.8
60-50-60	310.4
*100-50-60	343.4
100-50-60	343.2

* Side dressed with 40 lbs. nitrogen at time of cultivation in addition to the fertilizer plowed under.

Cropping history and past management
Oats and potatoes were grown alternately for several years.

Description of soil:
The soil was well drained loess over till.

Interpretation of results:
The application of phosphorous alone gave a good response. The relatively high yield of the check plot compared to the plot where 100 lbs. of nitrogen was added, indicates adequate supplies of available nitrogen in the soil at this location.
The inclusion of potash with the nitrogen and phosphate fertilizer increased the yield considerably.